

### Rejections Under 35 USC § 112

Claims 1-21 were rejected under 35 USC § 112, second paragraph, as being indefinite for failing to indicate where the vacuum is maintained in the methods recited in Claims 1 and 16. These claims have been amended to include the language "in said reactor chamber", thus removing any possible ambiguity as to where the vacuum is maintained. Applicant respectfully requests withdrawal of this basis of rejection in view of the above amendments.

### Double Patenting

Claims 1-21 have been provisionally rejected under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-27 of co-pending Application Serial No. 09/925,391. Applicants respectfully traverse this basis of rejection. The cited application is a continuation-in-part of the present invention. The use of metal dust is not an obvious modification to the presently claimed processes, and none of the cited references teach the benefits of using metal dust, in combination with a clay catalyst, to provide an improved process, requiring less energy input and having superior end products. Applicants respectfully request withdrawal of this basis of rejection.

### Rejections Under 35 USC § 103

The Office Action notes that this application currently names joint inventors. The claims now under consideration, Claims 1-21, (22-26 being withdrawn) were jointly invented.

Claims 1-21 were rejected under 35 USC § 103(a) as being unpatentable over Gi (4,463,203) in view of either Roy (4,740,270) or Solbakken et al. (4,250,158) when considered with prior art said to be admitted by applicants. Applicants respectfully traverse this basis of rejection.

As amended, Claim 1 now recites that heating occurs in three phases and fuel input is adjusted to take advantage of the exothermic nature of the reaction. Claim 16 also recites this feature, although the process is carried out without the use of a catalyst. Applicants respectfully submit that none of the cited references teach or suggest this aspect of the invention. Gi is cited for allegedly disclosing a pyrolysis process which uses bentonite, and which also contains metals such as magnesium and aluminum. This reference is apparently combined with Solbakken or Roy, said to disclose similar processes under low pressure, to arrive at the present invention. Applicants respectfully disagree with the characterization of the references.

The process of Gi shows many distinctions from the process claimed in the present invention. Gi is trying to overcome a different prior art problem and does not use rubber as a sole material; Gi uses a mixture of waste materials and does not disclose the size of the input materials. Further, Gi does not disclose the use of clay as a catalyst; bentonite is described in Gi as an anti-stick agent, and brown coal is used as a catalyst. Finally, the process of Gi is not carried out in three phases, as recited in the claims of the present invention. Gi uses much higher temperatures than Applicants': at column 1, line 14, a pyrolysis temperature range of 600-700 °C is disclosed, which converts to 1112 -1292°F. The example shows use of even higher temperatures, 700-800°C (col. 4, line 55). The text at column 2, lines 30-51, does not teach the use of different heating phases, but merely describes at what temperature the various reactions will occur. →

Roy is cited for teaching a low pressure pyrolysis process, but Roy does not teach the use of a clay catalyst, nor a process in which heating is carried out in at least three phases. Solbakken is also cited for teaching a low pressure pyrolysis process but in fact, Solbakken uses positive pressure of 1-20 psia; 1-20 psia is not a vacuum. The process of Solbakken shows other differences from the method of the present invention. Solbakken heats the waste material to loosen fibers and then separates the pieces before complete pyrolyzation, and uses temperatures which are generally higher than those used in the present invention. Solbakken does not describe a process in which the heating is carried out in three phases.

None of the cited references teach or suggest a method of pyrolysis in which the heating is carried out in at least three phases, to take advantage of the exothermic nature of the reaction. As can be seen in Figure 3, two heat sources are shown at each end of the reactor chamber. These heat sources can be adjusted independently, to provide minimal fuel input when, during the course of the reaction, less is needed. In a batch process, the fuel input can be adjusted over time (by microprocessor, for example), to take advantage of the energy of the reaction.

Applicants agree with the Examiner's assertion that pyrolysis is a naturally exothermic reaction; this fact is well known. However, none of the cited references have provided a means for taking advantage of this fact, in the methods and apparatus disclosed therein. The most recent reference, Roy, was issued in 1988, fifteen years ago. The other references are even older. Thus, at least 15 years have passed, and yet no one has come up with a method of pyrolysis that takes advantage of the exothermic nature of the reaction by

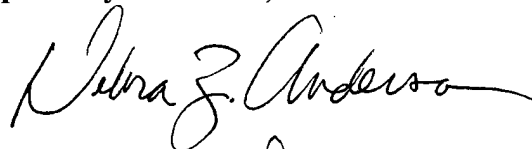
heating in separate phases, as accomplished in the present invention. Applicants respectfully submit that if this aspect of the invention were so obvious, this task would have been achieved long ago.

Applicants submit that none of the cited references disclose or suggest a pyrolysis method in which heating occurs in three phases and fuel input is adjusted to take advantage of the exothermic nature of the reaction, and therefore the references cannot be combined to produce this result. A teaching or suggestion of the claimed combination and a reasonable expectation of success must be found in the prior art references to support a rejection under 35 U.S.C. § 103. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The mere fact that references can be combined does not render the combination obvious unless the prior art suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). There is no such suggestion in any of the art discussed above, nor do any of the references provide the missing teachings. Copies of all cases are enclosed.

#### **SUMMARY**

As all outstanding issues have been addressed, Applicants submit that Claims 1-21 are in condition for allowance; such action is respectfully requested at an early date.

Respectfully submitted,



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## APPENDIX

## MARKED VERSION TO SHOW CHANGES MADE

Additions are noted by underlining

In the claims:

Please cancel Claim 11.

1. (Amended) A low energy method of pyrolysis of hydrocarbon material comprising:

- providing said hydrocarbon material;
- loading said hydrocarbon material into a reaction chamber;
- adding a catalyst to said reaction chamber, and
- heating said reaction chamber for a sufficient time to provide substantially complete pyrolysis,

said heating occurring in at least a first, second and third phases and fuel input is adjusted to take advantage of the exothermic nature of the reaction;

said method occurring while maintaining a vacuum in said reaction chamber and yielding reaction products comprising a solid carbonaceous residue, a liquid hydrocarbon product and a combustible gas.

12. The method of Claim ~~11~~1, wherein said first, second and third phase occur sequentially over time.

13. The method of Claim ~~11~~1, wherein said first, second and third phase occur sequentially over space, as said hydrocarbon material moves through said reaction chamber.

15. The method of Claim ~~11~~1, wherein said vacuum is maintained at pressure of between about 2 inches to 16 inches mercury.

16. (Amended) A low energy method of pyrolysis of hydrocarbon material comprising:

- providing said hydrocarbon material;
- loading said hydrocarbon material into a reaction chamber;
- heating said reaction chamber, said heating occurring in at least a first, a second and a third phase; and
- adjusting input of fuel to take advantage of the exothermic nature of the reaction, said method occurring while maintaining a vacuum in said reaction chamber and

yielding reaction products comprising a carbonaceous solid residue, a liquid hydrocarbon product and a combustible gas.